macaques and mice. Rakic and colleagues[1] now report that the ganglionic eminence also produces interneurons for the human neocortex, but the contribution is minor (35%). Instead, and most notably, they find that 65% of the interneurons arise locally from the cortical VZ/SVZ (Fig. 1a).

This source has two defining qualities. First, the cells migrate as chains, using each other as scaffolding to glide along; second, they express Mash1, a transcription-factor marker for interneuron progenitors. Surprisingly, Rakic and colleagues found that Mash1-positive progenitors reside mostly in the SVZ — a secondary germinal zone traditionally associated with the generation of another, non-neuronal cell type, glial cells. This implies that the cortical environment can nurture and support two types of developing neuron that are born at adjacent addresses (projection neurons in the VZ, and interneurons in the SVZ).

In the most telling experiments, Rakic and co-workers[1] infected cell progenitors in the cortical VZ/SVZ with a retrovirus carrying a gene tracer so that they could follow cell division and cell movement. By direct imaging of the infected cells, they showed that cells producing GABA also expressed the genes encoding Mash1 and Dlx1/2. But the idea that the interneuron source in the cortical VZ/SVZ is unique to humans needs to be counterbalanced by the finding that, in mice without Dlx1/2, a quarter of the cortical interneuron population still exists. The implication is that in other mammals interneurons are also generated locally in the cortical VZ.

Critics would also argue that the larger cortical interneuron source in humans might simply reflect a boosting of pre-existing developmental mechanisms. Indeed, Mash1 is expressed in certain cortical progenitors in mice[9]. Alternatively, the novel source of Mash1 progenitors in humans might arise from the evolutionary duplication of comparable cells in the ganglionic eminence. From work with rodents it seems that a single genetic switch is all that it takes — misexpression of Mash1 in cortical neurons results in their transformation to the interneuron type[10]. In this respect, laboratory studies with rodents might have recapitulated an event in human evolution.

Clarification of certain points raised by the new work[1] will be required. For instance, Rakic and colleagues show that interneurons actually migrate tangentially in the VZ/SVZ at first, followed by radial migration in the zone beyond that. In rodents, interneurons arising from ganglionic eminences behave in a similar manner, initially travelling close to the VZ as depicted in Fig. 1b, and subsequently changing tack to the radial direction[11]. As Rakic and colleagues admit, they cannot exclude the possibility that some of the Mash1-positive cells in the VZ/SVZ might have arrived from the ganglionic eminence at earlier embryonic stages and then continued to divide locally.

What about the evolutionary aspect? The primate neocortex is disproportionately large compared with that of other mammals, whereas the subcortical structures show only linear increases in size[12]. Evolution of the relatively large neocortex would disturb the scaling of shared developmental processes between cortical and subcortical structures; and it would require a numerical increase in interneurons, which would also have longer distances to travel. Might the VZ of the ganglionic eminence (committed, of course, also to interneuron production for the thalamus) have been hard pressed to meet demand, resulting in the adaptational production of interneurons in the cortical VZ? There is also a temporal consideration. In humans, neuron migration into the neocortex occurs over a period of 200 days, compared with just 10 days in mice and 30 in ferrets. If interneurons were produced largely subcortically, as in rodents, it might be that the physical and molecular receptivity of the human cortical environment would become exhausted.

The debate about interneuron origins echoes lines from W. H. Auden's *Ode to the Diencephalon*: "How can you be quite so uncouth? After sharing the same skull for all these millennia, surely you should have discovered the cortical I is a compulsive liar." The cortical I — the interneuron cell type — has long been seemingly lying to observers about its behaviour. And then there is the medical connection. Malfunction of the GABA system is a hallmark of disorders such as schizophrenia[13], to which defects in interneuron migration can be a predisposing factor. So could those defects be responsible for the 'cortical lies' perceived by the sufferer? Even when origins of interneurons have been sorted out, questions such as this will continue to disturb the peace of neurobiologists. ■

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Daedalus

Toughened metal

Metallurgists are always trying to make stronger metals. One of their tricks is to mix molten metal with tiny solid particles, say of ceramic, to give a tough composite. The result is limited by poor adhesion between metal matrix and suspended particles; it also blunts cutting tools. Daedalus has a new plan.

Suppose, he says, you were to burn metal vapour, not in excess air or oxygen as a chemist would normally do it, but in excess metal vapour. The usual branched dendritic oxide particles would form; but on cooling they would get covered with metal from the surrounding excess vapour. Solid surfaces adhere strongly unless air or water vapour has coated them first (which is why solids hold together in the first place). So burning in excess metal vapour should give metal oxide particles pre-coated with metal.

DREADCO chemists are now trying it. They are burning metal vapours — aluminium, magnesium, zinc — in as little oxygen as possible; an inert-gas diluent may help. The cooled oxide particles should be superficially covered and wetted with metal.

This novel oxide should be easy to mix with melted metal. Unlike powdered ceramic, it should not float on top but, being already wetted with metal, will just seem to dissolve in the melt. The resulting 'Metox' composite will be greatly strengthened by its loading of fine oxide particles. Aluminium toughened by its own oxide should be more inextensible and much stronger than the metal itself. Magnesium and zinc should tell the same story. The chemists have many other metals to try — notably titanium. Sadly, metal oxide particles blunt the cutting tools used on metal. Metox composite will be best cast from the melt into its final form.

DREADCO's new Metox composites should be ideal for superchargers and turbine blades. Zinc binds conveniently firmly to iron (hence 'galvanized' zinc-plated steel sheets), so zinc-coated zinc oxide particles should mix readily with melted iron alloys. Daedalus also recalls how the graphite inclusions in cast iron make it remarkably silent. Silent Metox composites, or at least highly damped ones without the 'ring' of steel, would be a splendid contribution to our noisy civilization. But Daedalus's ultimate goal is a Metox with so much oxide that it is compatible with ceramics. It would be ideal for the pistons and cylinder-blocks of adiabatic engines, with no cooling system. They just run hot.

David Jones